PUBLISHED QUARTERLY AT 6s.
OCTOBER, JANUARY, APRIL, JULY.

Entered at New York Post Office as Second Class Matter.

JOURNAL OF ANATOMY AND PHYSIOLOGY

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VOL. L.

THIRD SERIES.—VOL. XI.

PART IV.

JULY NUMBER, 1916

LONDON: CHARLES GRIFFIN AND COMPANY, LIMITED, EXETER STREET, STRAND 1916

Annual Subscription, 21s. post free.

BIOMETRIKA

A Journal for the Statistical Study of Biological Problems

Founded by W. F. R. WELDON, FRANCIS GALTON and KARL PEARSON. Edited by KARL PEARSON

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JOURNAL OF ANATOMY AND PHYSIOLOGY

SUR LA STRUCTURE DU POUMON DU DAUPHIN (*DELPHINUS DELPHIS*).

Par le Dr José Martins Barbosa, *Assistant d'histologie à la Faculté de Médecine de Pôrto (Portugal).*

(Travail du laboratoire d'histologie de la Faculté de Médecine de Montpellier.)

Le poumon du Dauphin présente des particularités de structure macroscopique qui ont déjà été signalées,[1] mais il offre aussi un certain nombre de points intéressants d'anatomie microscopique, sur lesquels je désirerais attirer dès maintenant l'attention. Ces points sont les suivants:

I. La présence de sphincters bronchiques.

II. Le mode de ramification des bronches terminales.

I. Sphincters bronchiques.

Les sphincters bronchiques, dont la présence chez le Dauphin m'a été signalée par M. le Professeur Vialleton, qui m'a conseillé d'en faire l'étude, sont de petits anneaux musculaires lisses placés régulièrement les uns à la suite des autres, dans les bronches de petit calibre.

Ces sphincters qui n'ont été décrits que je sache par aucun auteur, et qu'il ne faut pas confondre avec les très délicats sphincters décrits par Rindfleisch [2] à l'entrée des conduits alvéolaires chez certains animaux, sont très nombreux et très développés chez le Dauphin.

Pour les bien voir, il faut absolument faire des coupes parallèles à la direction générale des bronches, c'est-à-dire dirigées sur le poumon d'avant en arrière. Les coupes perpendiculaires à l'axe du poumon ne donnent que des mauvais résultats à ce point du vue, ce qui s'explique du reste

[1] Voir comme description d'ensemble :

Cuvier, G., *Leçons d'anatomie comparée*, 2e éd., 1840, tome vii. pp. 101 *et suivantes.*

Owen, Richard, *On the Anatomy of Vertebrates*, Vol. iii., *Mammals*, 1868, pp. 578 *et suiv.*

Bouvier, *Les Cétacés souffleurs*, "Thése d'agrégation de l'Ecole Supérieure de Pharmacie de Paris," 1889, pp. 57 *et suiv.*

Oppel, *Lerbuch der vergleichenden mikroskopischen Anatomie der Wirbeltiere*, Sechster Teil. Atmungs apparat.

[2] Rindfleisch, cité par Oppel, *loc. cit.*, p. 653.

aisément. On sait en effet que les bronches chez le Dauphin ont principalement une direction cranio-caudale. Elles divergent fort peu les unes des autres et s'unissent sous des angles très aigus.

Lorsqu'elles ont atteint un diamètre un peu inférieur à un millimètre, ces bronches examinées à l'œil nu sur un poumon durci par le formol, montrent sur les coupes longitudinales, une lumière presque entièrement obliterée de distance en distance par des festons saillants, qui se font face.

C'est la manifestation macroscopique des sphincters comme on s'en rend très bien compte par la suite.

Après un certain nombre de ces sphincters, huit à dix, la bronche se divise brusquement en un bouquet de bronches plus petites, qui, contrairement aux rameaux précédents, divergent assez fortement les unes des autres et se dirigent d'abord perpendiculairement pour prendre ensuite une direction à peu près parallèle à celle du tronc d'origine, de manière que les conduits bronchiques présentent dans ce moment une direction en baïonnette (fig. 1, A).

Les sphincters se continuent dans toute la portion coudée des conduits bronchiques et disparaissent un peu plus loin sur les bronches terminales.

Les dernières bronches sur lesquelles on trouve encore des sphincters, ont un peu moins de la moitié du diamètre de celles qui montrent les premiers sphincters. En effet ces derniers s'observent sur des rameaux bronchiques dont le diamètre, mesuré au dehors du cartilage, est en moyenne de 0·7 mm.—sept-dixièmes de millimètre—tandis que les plus petites bronches à sphincter ont un diamètre correspondant à trois ou quatre dixièmes de millimètre—0·3 mm. à 0·4 mm. On verra un peu plus loin que les bronches terminales sont un peu plus larges.

On comprend aisément par là que seules les coupes parallèles à la direction des conduits bronchiques auront chance de montrer les sphincters dans leur distribution régulière, et par suite de faire bien comprendre leur disposition et leur signification, tandis que des coupes transversales, ne montrant que des sphincters isolés, et le plus souvent mal orientés dans la coupe, n'attirent point l'attention.

Le plus sûr moyen de suivre bien exactement dans les coupes le trajet des conduits bronchiques est de s'adresser à des points du poumon où les bronches cheminent dans une mince lame pulmonaire qu'il est facile de couper parallèlement à ses faces.

Ces lames minces du poumon s'observent sur la face ventrale de l'organe au voisinage du bord tranchant; elles ont été signalées par divers auteurs et Königstein[1] en a donné en 1903 une figure assez exacte quoique très schématique.

[1] Königstein, Hans, "Notiz zur einer Cetaceenlunge (*Delphinus Delphis*), *Anat. Anz.*, Jena, No. 23, 1903, Bd. xxii. Ss. 497–500, Fig. 2.

Les sphincters siègent dans l'épaisseur de la muqueuse bronchique immédiatement au-dessous de l'épithélium qu'ils soulévent fortement et qui s'amincit à leur niveau. Ils sont donc placés en dedans des cartilages et plus exactement entre deux anneaux cartilagineux consecutifs.

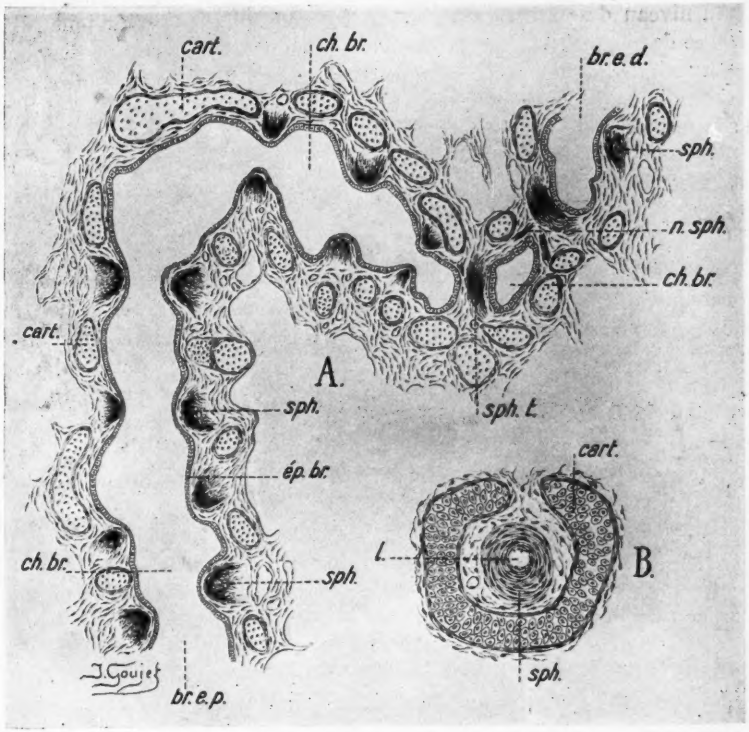


FIG. 1.

A.—Coupe parallèle à la surface de la paroi amincie du poumon.

br.e.d., bronche extrémité distale; *br.e.p.*, bronche extrémité proximale; *cart.*, cartilage; *ch.br.*, chambres bronchiques circonscrites par les sphincters; *ép.br.*, épithélium bronchique; *n.sph.*, nœud de sphincters; *sph.*, sphincters; *sph.t.*, sphincter coupé tangentiellement.

B.—Bronche coupée transversalement pour montrer un sphincter.

cart., cartilage; *l.*, lumière au centre du sphincter; *sph.*, sphincter.

On sait depuis longtemps que les cartilages des grosses bronches forment chez les cétacés, des cercles complets, ou plus exactement une spire continue dont tous les tours se touchent presque. Cette spire se décompose en segments comprenant chacun deux tours complets et se terminant à leurs

extrémités en pointes, qui s'accolent aux extrémités correspondantes des segments adjacents, pour former avec eux la spire continue. Cette disposition se poursuit jusque sur les petites bronches et elle ne s'arrête qu'au point où paraissent les premiers conduits alvéolaires, sans que pour cela le cartilage disparaisse complètement comme on le verra plus loin.

Au niveau des bifurcations, le cartilage en spirale se complique par la présence de plaques larges en forme d'écusson ou de croissant de manière à constituer partout un revêtement cartilagineux solide, ne laissant aucune partie un peu développée de l'arbre bronchique dépourvue de cette formation de soutien.

Les sphincters musculaires siègent toujours, comme il a été dit, entre deux cartilages consécutifs, mais comme leur épaisseur est assez considérable ils empiétent parfois un peu sur les cartilages voisins.

Chaque sphincter est formé par un anneau de fibres musculaires lisses disposées transversalement et fait une saillie assez forte dans la lumière bronchique, qu'il rétrécit par places au point de l'oblitérer a peu près complètement. Entre les fibres musculaires existe un réseau fin de fibres elastiques bien mises en evidence par l'orcéine, et qui s'épaissit considérablement sur la face libre de l'anneau musculaire. Ce réseau élastique sphinctérien se poursuit aussi sur les côtés et va se continuer d'une part avec les réseaux élastiques enveloppant les cartilages, d'autre part avec les formations élastiques du tissu conjonctif dont Max Weber a fait remarquer la richesse particulière chez les cétacés.[1]

Dans la bronche représentée, fig. 1, A, le sphincter le plus étroit que j'ai mesuré avait exactement 62 μ de diamètre intérieur, et le plus large mesurait 280 μ ; la moyenne de la largeur des sept sphincters représentés dans cette figure était de 165 μ, c'est-à-dire un dixieme et demi de millimètre—0·15 mm.

Dans la fig. 1, B, qui représente un sphincter coupé en travers, la lumière était encore plus réduite et ne mesurait que 47 μ, soit par conséquent pas même un demi-dixième de millimètre—0·047 mm.

Il résulte de ces observations et d'autres faites sur des pièces macroscopiques durcies au formol, que les sphincters s'observent dans deux points différents, mais consécutifs de l'arbre bronchique :

1° Sur des troncs qui mesurent un peu moins d'un millimètre de diamètre extérieur.

2° Sur les rameaux qui naissent de ces troncs et s'écartent à angle droit en formant des conduits plus fins et dont le diamètre descend jusqu'à un peu moins d'un demi-millimètre.

Il est clair que ces formations musculaires sont parfaitement capables

[1] Max Weber, *Die Säugetiere*, Jena, 1904, p. 227.

de fermer complètement les bronches, surtout au niveau des points de l'arbre bronchique où va se faire la division des bronches indiquée plus haut. Dans ces points les sphincters se multiplient, et par la distribution même des ramifications bronchiques qui s'effectue à angle droit, il arrive fréquemment que les sphincters de deux bronches voisines s'entrecroisent obliquement et forment ainsi des nœuds musculaires d'une efficacité encore plus marquée (fig. 1, A, *n.sph.*).

Il est fort probable que ces sphincters aussitôt l'inspiration achevée, maintiennent l'air enfermé dans les terminaisons bronchiques au delà desquelles ils se trouvent, et qu'ils se relâchent brusquement au moment de l'expiration. Cette disposition est sans doute en rapport avec les plongées de l'animal.

Dans les bronches où ils commencent à se montrer les sphincters sont régulièrement espacés et isolent entre eux des chambres mesurant en moyenne 419 μ de longueur et 432 μ de largeur. Dans les chambres représentées, fig. 1, A, celle qui présentait la plus petite longueur mesurait 187 μ et la plus longue présentait 718 μ; comme largeurs limites nous avons obtenu pour la chambre la plus étroite 156 μ et la plus large a donné à la mensuration le chiffre de 500 μ, c'est-à-dire 0·5 mm., en comptant toujours ces chiffres du côté intérieur. Dans les bronches plus petites les sphincters sont encore plus serrés.

Les chambres bronchiques limitées pas les sphincters possèdent un réseau capillaire sanguin à mailles arrondies tout à fait analogue à celui des alvéoles pulmonaires et qui se déverse dans la veine pulmonaire, comme j'ai pu m'en convaincre sur des fœtus de Dauphin au niveau de la portion amincie du poumon, où existait une véritable injection naturelle très facile à observer dans les préparations éclaircies.

Bien que, après la mort, les sphincters soient toujours ouverts, ils opposent cependant une certaine difficulté à la pénétration des injections bronchiques.

J'avais été surpris de n'obtenir avec la masse métallique de Wood, qu'une pénétration assez imparfaite, la masse ne depassant jamais les ramifications mesurant moins d'un demi-millimètre, mais j'ai pu voir par la suite qu'à l'extrémité de ces ramifications l'empreinte annulaire des sphincters se voyait déjà et que c'étaient évidemment eux qui avaient arrêté la progression de la masse. De plus les étranglements produits par les sphincters rendent très cassantes les extrémités des rameaux bronchiques injectés qui sont pour la plupart perdues lorsqu'on nettoie la pièce après corrosion.

Dans tout le territoire bronchique où se rencontrent les sphincters, ces derniers représentent seuls la musculature bronchique, il n'existe pas de fibres musculaires au dehors d'eux. Les sphincters s'observent déjà chez

des fœtus d'assez grande taille. La fig. 2 en représente une série, dans un poumon de fœtus de 55 cm. Les anneaux musculaires sont déjà bien développés et ferment presque complètement la lumière bronchique.

Les pièces cartilagineuses sont déjà aussi visibles, les conduits alvéolaires sont bien développés. On voit en divers endroits la lumière bronchique presque entièrement effacée par la forte saillie des sphincters, et à ce niveau l'épithélium bronchique est fortement aminci comme on le voit particulièrement vers l'extrémité distale de la bronche (fig. 2, *br.e.d.*). Au voisinage de

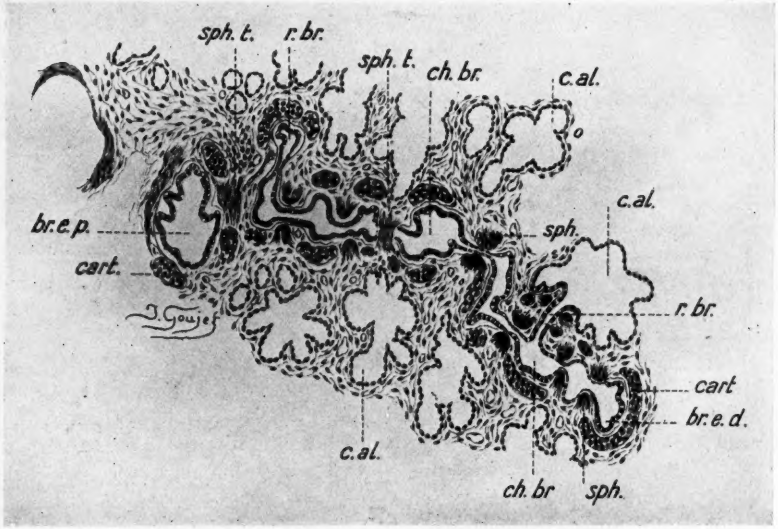


FIG. 2.—Coupe sagittale du poumon d'un fœtus de Dauphin de 0·55 centimètre.

br.e.d., bronche extrémité distale; *br.e.p.*, bronche extrémité proximale; *c.al.*, conduits alvéolaires; *cart.*, cartilage; *ch.br.*, chambres bronchiques; *r.br.*, rameaux bronchiques; *sph.*, sphincter; *sph.t.*, sphincters coupés tangentiellement.

cette extrémité un rameau bronchique (fig. 2, *r.br.*) est implanté à angle droit sur la bronche et il est muni d'un sphincter au voisinage du point où il s'élargit, brusquement passant alors dans un conduit alvéolaire.

II. Mode de ramification des bronches terminales.

Les bronches terminales font suite à des bronches de petit calibre qui mesurent environ 0·25 mm.—deux-dixièmes et demi de millimètre—et qui présentent des sphincters. Elles sont plus volumineuses et leur calibre va

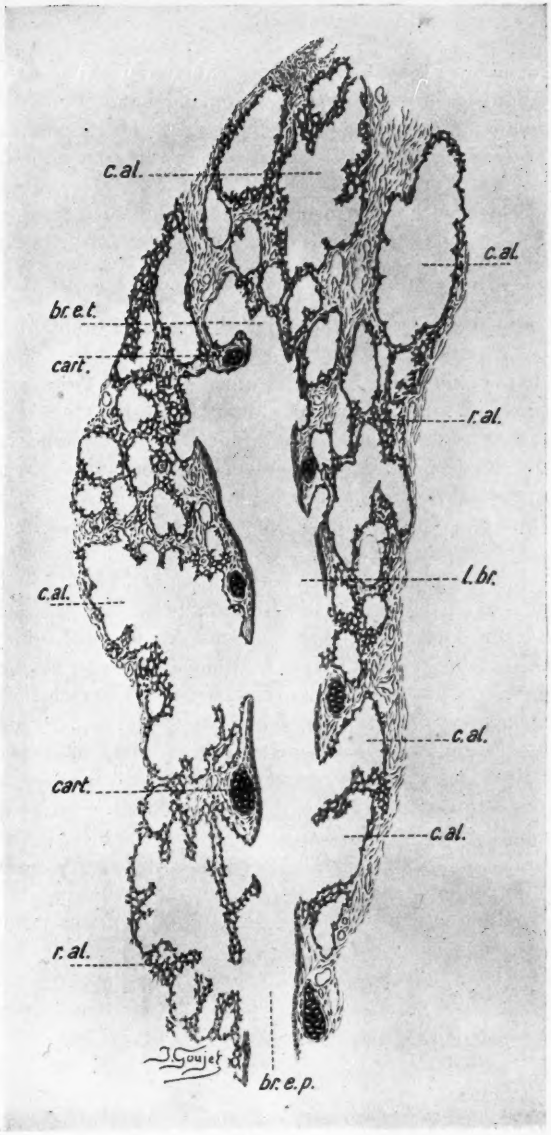


FIG. 3.—Coupe parallèle à la surface dans la partie amincie du poumon (extrémité terminale de la bronche représentée fig. 1).

br.e.p., bronche extrémité proximale; *br.e.t.*, bronche extrémité terminale; *c.al.*, conduits alvéolaires; *cart.*, cartilage; *l.br.*, lumière bronchique; *r.al.*, réseau capillaire des alvéoles dans les parties de ceux-ci que sont vus de face.

même regulièrement croissant jusqu'à leur extrémité comme on le voit bien dans la fig. 3, dont la bronche mesure 3 mm. de longueur et dans son extrémité proximale nous montre une largeur de 250 μ, pendant que dans le milieu elle mesure à peu près 312 μ et à son extrémité distale elle présente la largeur assez considérable de 470 μ.

La paroi de la bronche est formée par la muqueuse renforcée ça et là par des plaques cartilagineuses assez écartées les unes des autres. Ces plaques se poursuivent sur toute l'étendue de la bronche et on trouve toujours un petit nodule cartilagineux à l'extrémité de celle-ci, entre les derniers conduits alvéolaires qui en naissent et qui continuent à peu près sa direction.

Sur tout le pourtour de la bronche ainsi constituée s'ouvrent des conduits alvéolaires qui se ramifient plus ou moins. La plupart d'entre eux sont implantés à angle droit sur la bronche dans laquelle ils s'ouvrent largement.[1] Seuls derniers conduits alvéolaires ont une direction oblique et prolongent pour ainsi dire la bronche sur une certaine longueur.

Ainsi chaque bronche terminale occupe l'axe d'un manchon de cavités respiratoires greffées sur elle, et cet axe est pourvu sur toute sa longueur de nodules cartilagineux plus ou moins développés. Il n'y a point de bronches sans cartilage, et d'autre part la distribution régulière des conduits alvéolaires tout autour de la bronche axiale constitue un mode de ramification tout à fait distinct de celui qui s'observe chez l'Homme et chez beaucoup d'autres Mammifères et que M. le Prof. Laguesse a caractérisé par le mot très just de *ramifications* en *choux-fleur*.[2]

Dans toute l'étendue de la bronche terminale, on n'observe point des fibres musculaires lisses, et celles-ci paraissent aussi manquer dans les conduits alvéolaires.

Malgré tout l'attention que j'ai apporté à les rechercher, je n'ai point trouvé non plus d'anneaux musculaires lisses autour de l'ouverture des conduit alvéolaires dans la bronche axiale, de sorte que les sphincters décrits par Rindfleisch pour certains animaux manquent absolument chez le Dauphin.

Dans toutes les coupes les réseaux capillaires gorgés de globules rouges, à cause de l'état asphyxique auquel a succombé l'animal, se voient admirablement et ils ont été représentés dans la fig. 3 partout où la paroi alvéolaire se voyait de face.

[1] Les mensurations que j'ai obtenu pour l'ouverture de ces conduits alvéolaires qui sont représentés fig. 3 sont : à droite 312 μ et 218 μ, et à gauche 312 μ.

[2] Laguesse, E., "Trois leçons sur la structure du poumon," Extrait de *l'Écho Médical du Nord*, 1901, p. 36.

AN UNUSUAL PERITONEAL SAC.

By F. A. Hepworth, M.A., M.B.(Camb.), F.R.C.S., *Demonstrator in Anatomy.*

(From the Anatomical Department, Sheffield University.)

The subject was an adult male; death had apparently resulted from melanotic sarcoma, and had no relation to the abnormal abdominal condition here described.

On opening the abdomen, attention was at once drawn to a smooth cyst occupying a large part of the left side of the cavity. The stomach and transverse colon were normally situated and contracted; the shrunken great omentum lay obliquely across the upper abdomen, leaving the contents of the lower part exposed to view. Below the right (lower) end of the curled-up omentum was the cæcum, rather distended and turned upwards from the iliac fossa with its fundus pointing towards the middle of the abdomen. Below the left part of the omentum was placed the cyst, and the only portion of the small intestine visible on first examination was the terminal two feet of ileum which occupied the hypogastric area, below the cæcum and the cyst (fig. 1).

By drawing the cæcum to the right and turning the coil of ileum upwards, the appendix and ileo-cæcal junction were brought into view. To the left of them, almost in the middle line of the body, there was an opening through which the ileum emerged from what at first sight appeared to be a retro-peritoneal fossa. But only an emerging coil was present; there was no entering loop as in a retro-peritoneal hernia (fig. 2).

The ascending colon lay far back in the right lumbar region and could not be seen, but the descending colon was just visible on the outer side of the cyst.

The cyst itself was next examined and found to be thin-walled, membranous, and not adherent to colon, omentum, or other organs. It was obviously peritoneal, showing no signs of being pathological in origin. When opened it was seen to be closely filled by coils of small intestine, and on drawing these out the extent of the cavity was revealed. It was a smooth-walled space, extending from the level of the 9th rib in the anterior axillary line down to the posterior part of the iliac crest; medially it reached as far as the middle line, and laterally almost to the abdominal wall. The whole space was lined by peritoneum which was in direct con-

tact behind with the anterior surface of the left kidney, the tail of the pancreas, the ascending portion of the duodenum and duodeno-jejunal junction, and lower down with the aorta and left lumbar muscles (fig. 3). Traced to the right, the peritoneal lining was found to pass from the duodenum on to the posterior, or inferior, aspect of the mesentery, following the course of the normal parietal peritoneum; but to the left it reached

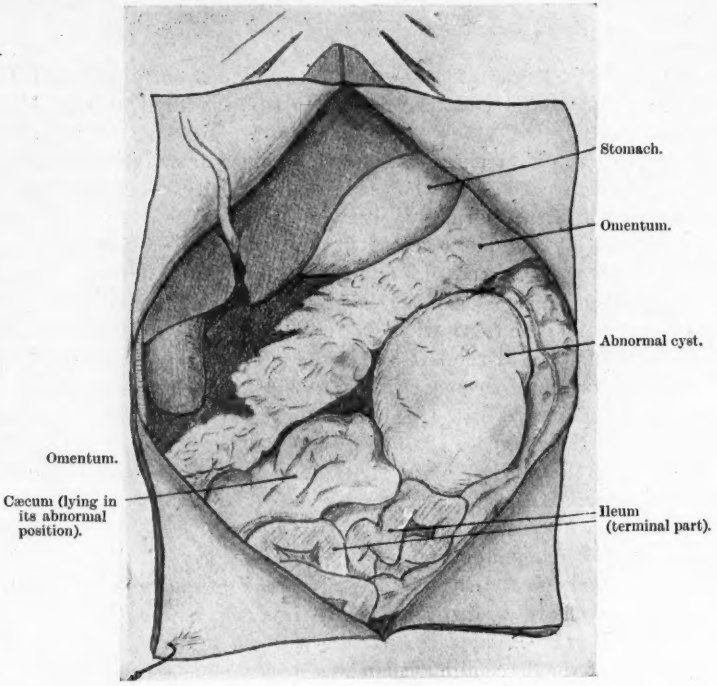


Fig. 1.

well into the flank, turned forwards behind the descending colon, and then passing inwards to form the anterior wall of the cavity, it joined the layer of peritoneum which covered the front of the descending colon. The anterior cyst-wall was therefore a double sheet of peritoneum, and the two layers could be separated with comparative ease as far back as their reflection from the abdominal wall in the neighbourhood of the descending colon. The division could be followed upwards also as far as the transverse mesocolon, to the under surface of which the cyst-wall was attached, but

here the attempt to continue the separation up to the root of the mesocolon only resulted in tearing the layers and so losing the distinction between them. In the downward direction, separation was difficult, but inspection of the surfaces led one to believe that the superficial layer was continued down over the iliac fossa to become the sigmoid mesocolon, while the deep layer was reflected on to the abdominal wall at the back of the cavity.

Separation of the two layers again became difficult when the anterior

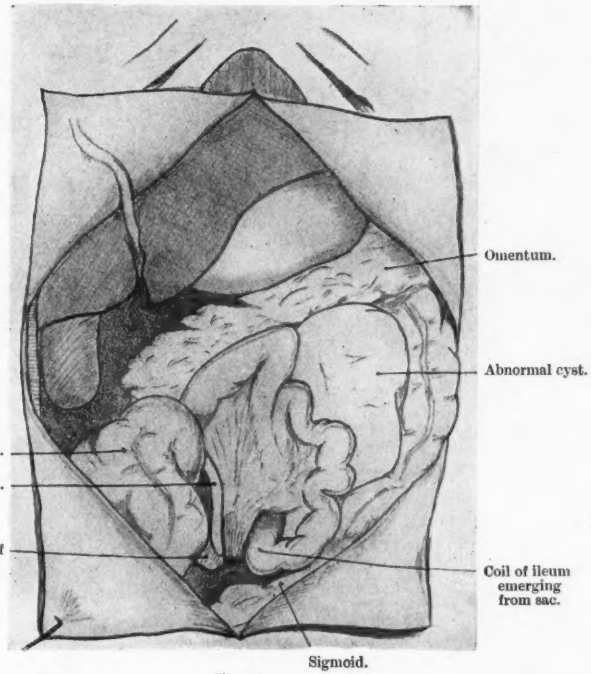


FIG. 2.

wall was followed towards the middle line. Enclosing, as it did, almost all the small intestine, the sac also included all the corresponding part of the convoluted edge of the mesentery. But the front of the sac was firmly bound down to the anterior or upper surface of the mesentery not far from its root, along a line of attachment rather more vertical than that of the root of the mesentery. The line of attachment was marked by considerable thickening, and it was impossible to identify two separate layers, or to say whether they were continuous with the peritoneum of the mesentery or

secondarily adherent to it. The band of thickened peritoneum was continued downwards as the fold which formed the anterior (left) margin of the outlet from the sac, and could be traced downwards and to the left over the sacral prominence to the iliac fossa, where, as already mentioned, the anterior wall of the cyst appeared continuous with the sigmoid mesocolon. Followed upwards, this attachment of the cyst-wall passed from the

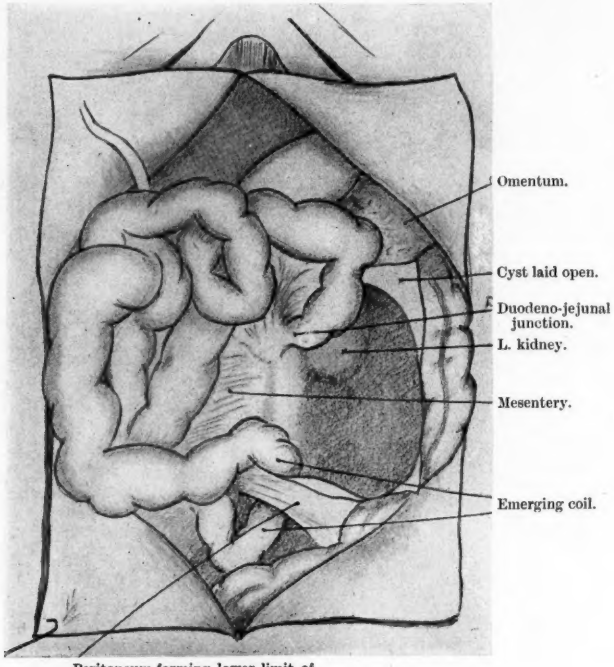


FIG. 3.—The cyst opened and its contents turned out.

mesentery to the posterior abdominal wall just mesial to the duodeno-jejunal junction, and above that became fused with the transverse mesocolon.

The contents of this abnormal sac were small intestine and mesentery, from the duodeno-jejunal junction to within two feet of the ileo-cæcal valve. The bowel made its exit from the cavity by passing through a tunnel of peritoneum formed by the attachment of the anterior wall of

the sac to the anterior (upper) aspect of the mesentery, and by the thickened free edge of this wall as it left the mesentery to gain the posterior abdominal parietes in the neighbourhood of the last lumbar vertebra. The tunnel was directed downwards and a little to the right, and lay in front of the prominence formed by the spinal column, aorta, and inferior vena cava.

The explanation of this unusual abnormality is difficult, but the peritoneal arrangements seem to suggest that a fold arising from the mesocolon —from near the middle of the transverse to the middle of the sigmoid— had become adherent by its margin to the right of the mesentery of the small intestine, and had thus enclosed the whole of the jejunum and greater part of the ileum (fig. 5); but the remainder of the peritoneal surface

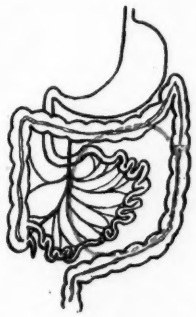


FIG. 4.—Diagram to show relation of cyst-wall attachments to small intestine, mesentery, and colon.

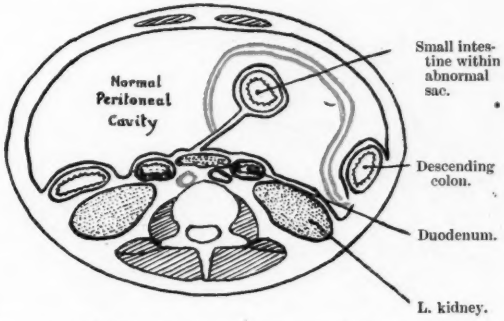


FIG. 5.—Diagram of peritoneal arrangement at level immediately below duodeno-jejunal junction. Wall of abnormal sac shown by double red line; normal peritoneum by black line.

showed nothing suggesting disease, and the cyst-wall had the appearance of normal peritoneum and not that of an inflammatory product.

I am led to conclude that the presence of the fold was due to an error in the process of development. It is significant that the contents of the cyst comprised that section of bowel which forms the proximal part of the umbilical loop during the second and third months of fœtal life; and that the abnormal peritoneal fold was closely connected at its margins with a little less than the left half of the transverse mesocolon and the descending and sigmoid mesocolon—that part, in fact, which is always intra-abdominal, and which occupies a median position until the withdrawal of the umbilical loop into the abdomen at about the tenth week.

In an interesting paper by Professor J. E. Frazer and Dr R. H. Robbins, in the *Journal of Anatomy and Physiology*, October 1915, "On the

Factors concerned in causing Rotation of the Intestine in Man," it is described how during the third month of development the bowel returns from the umbilical sac to the abdominal cavity, the proximal part of the umbilical loop returning before the distal, and filling up first the space to the right of the median mesocolon below the liver; as the bulk of returning coils increases, the median mesocolon is pressed to the left and carries the colon over until it rests upon the posterior abdominal wall, the umbilical loop then passing to the left also, and filling the space below the stomach and omental bursa (figs. 12, 13, and 15 in Frazer and Robbins' article).

It is conceivable that an abnormality may occur at this stage, and that as a result perhaps of an unusually long median mesocolon, the accumulating mass of returned intestine may simply cause a lateral bulging of mesocolon towards the left, without at first displacing the colon itself. Supposing

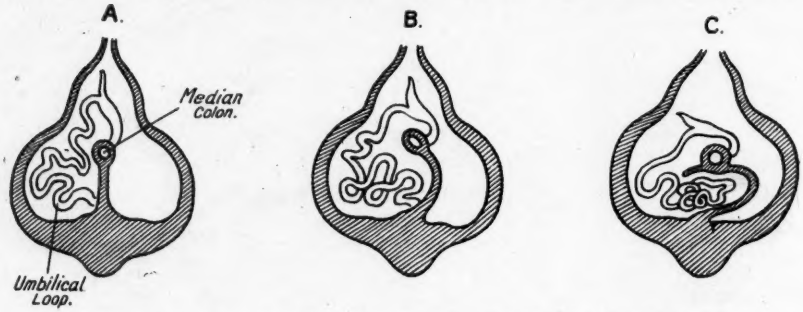


FIG. 6.—To show suggested mode of development of abnormal peritoneal sac.

this to occur, the right side of the mesocolon would form a concavity occupied by coils of intestine from the proximal part of the umbilical loop; and increasing pressure would tend to cause adhesion between the margin of this surface of mesocolon and the root of the mesentery (fig. 6, A, B, and C).

The later movement of the colon to the left would then cause a drawing out of the adherent surface, with the result that a new fold of peritoneum would pass from the mesocolon to the root of the mesentery, in front of the intestine from the duodeno-jejunal junction to the apex of the umbilical loop.

This theory does not explain the peculiar curled-up condition of the great omentum found in this subject, but a possible suggestion is that the omentum normally intervenes as a bursa between bowel and abdominal wall; and that in the presence of an abnormal peritoneal protection such as was formed by the sac described above, there was no need for an omental bursa, and the stimulus to its downward growth was lacking.

CONGENITAL DEFICIENCY OF THE PERICARDIUM.

By MARTIN R. CHASE, M.D.

(From the Anatomical Laboratory of the Northwestern University Medical School.[1])

A CONSIDERABLE number of cases of congenital deficiency of the pericardium have been recorded. Faber in 1878 collected ten cases. Ebstein, 1910, found thirty-two cases reported. Perna, 1910, and Plaut, 1913, have recently summarised the literature on the subject, and reported additional cases. The reader is referred to their papers for a complete consideration of the literature.

It is the purpose of this paper to present a short description of a case found in this laboratory. At the time the body came under our observation, all parts except the chest had been dissected, thus losing the identity of the subject.

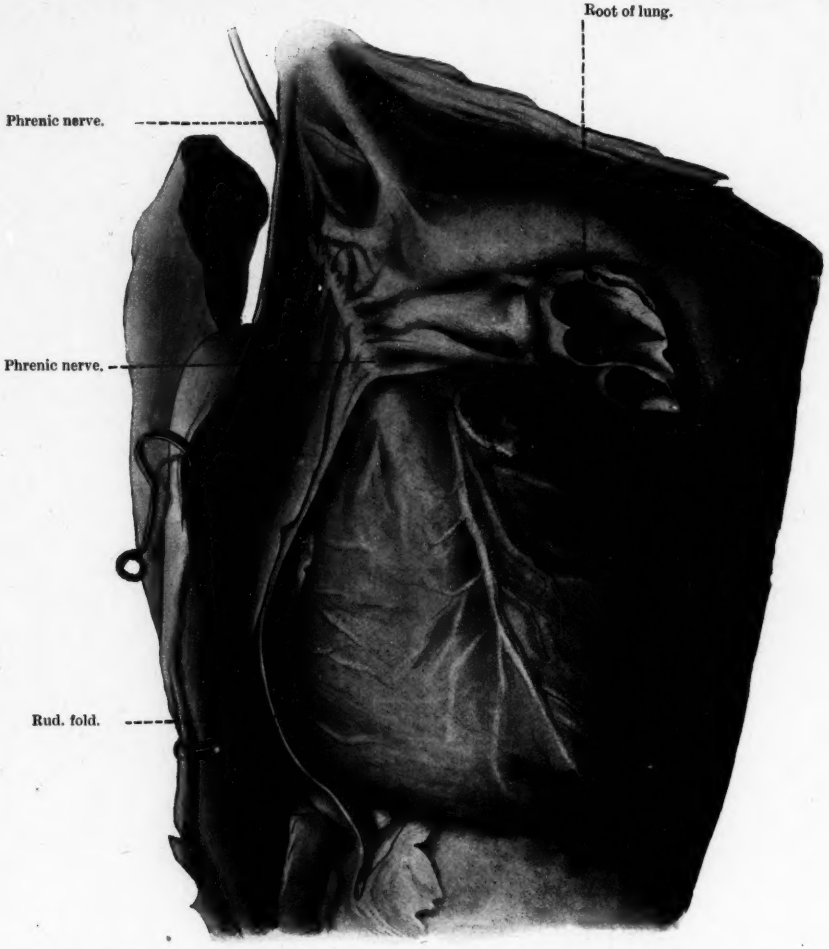
The chest was that of a fairly well-developed adult male presenting a marked kypho-scoliosis. On opening the right pleural cavity it was noted that there were extensive adhesions between visceral and parietal pleura, and evidence of tuberculous involvement of the right lung. The mediastinal partition seemed normal.

On opening the left pleural cavity, however, the left lung and the heart came clearly into view, lying in a common serous cavity. Examination shows that this is due to a large defect of the left half of the parietal pericardium. The visceral pericardium is normal. Around the base of the heart is a more or less sickle-shaped fold with a free border, which almost encircles and partially encloses the base of the heart. This fold begins on the superior aspect of the root of the left lung as a reduplication of the serous membrane about 1·5 cm. wide, having its attachment along a line passing horizontally forward, across the ascending aorta to the mediastinal partition, thence downward as a reduplication of the mediastinal pleura to reach the diaphragm just to the left of the sternal attachment of the 6th left costal cartilage. From this point a continuation extends upwards over the dome of the diaphragm, passing to the left of the inferior vena cava, to blend with the left pulmonary ligament.

Taken as a whole, the left portion of the pericardium may be considered as a reduplication of the serous lining of the common pleuro-pericardial

[1] Contribution No. 39.

cavity, encircling the base of the heart from the upper aspect of the root of the lung to the pulmonary ligament on the inferior aspect of the pulmonary



Drawing of heart from in front and to the right, showing cut section of pulmonary root, and rudimentary fold of pericardium with phrenic nerve. Owing to the deformity of the spinal column the aorta appears to bend sharply to the right.

root. It contains on the right side where it is attached to the mediastinal pleura, and at its anterior attachment to the diaphragm, thickenings of

fatty tissue which in places assume the shape of tags of fat covered with serosa.

The fold varies in width from 2·5 cm. along the mediastinum to 3·5 cm. where it is attached to the diaphragm. To the left and in front the visceral pericardium is directly in contact with the visceral pleura on the mediastinal surface of the left lung. More anteriorly and in the cardiac notch of the lung it lies against parietal costal pleura. Below, the heart is in contact with the diaphragmatic pleura.

The heart itself is of normal size and appearance. It is covered with serous pericardium which continues over the roots of the great vessels in a normal manner. The transverse and oblique sinuses of the pericardium are present. There are present no adhesions of the visceral pericardium with parietal pleura or lung, as was found in many of the cases reported, the serosa of the common pleuro-pericardial cavity being smooth and free in all parts. The heart shows no congenital defects. The ductus arteriosus and the foramen ovale are closed.

Phrenic Nerve.

The phrenic nerve enters the thorax behind the left innominate vein, courses downward to the left of the innominate vein, crosses the arch of the aorta anterior and a little to the left of the origin of the left common carotid artery, and enters the fold of pericardium at its attachment just below the arch of the aorta. It then turns to the right along the free border of the fold, which it follows to the diaphragm. In some of the cases reported no rudiment of pericardium was found. In others rudiments were present ranging from tag-like pads about the base of the heart to crescentic folds completely enclosing a part of the heart. In a case reported by Keith, in a fœtus presenting many other congenital anomalies, a small aperture was seen in the left side of the pericardium through which the left auricular appendage protruded. In Powell's case there was an opening only one-eighth of an inch in diameter in the left side of the pericardium, which had smooth edges and showed no signs of erosion. In his subject the condition of pneumo-pyothorax was present, and the pericardial sac contained air and pus.

The course of the phrenic nerve was, in all cases except Perna's, to the right of the deficiency. In cases of well-marked folds it ran in the fold near the free border. Where the fold was small or absent it ran in the mediastinal partition, between the two pleural sacs. In the cases of Versé and Picchi (quoted from Plaut) it ran in a fold behind the sternum In Perna's case the phrenic took a course across the root of the lung

posterior to the pulmonary artery to reach the posterior part of the diaphragm.

So far as known, the condition has no clinical significance and has never been diagnosed ante-mortem.

Keith thinks the explanation of the condition is that the lung-bud grows through the pleuro-pericardial foramen, expanding that opening, and preventing its normal closure.

Perna suggests that early establishment of the anastomosis between the left and right anterior cardinal veins results in early atrophy of the left duct of Cuvier (common cardinal vein). Inasmuch as the pleuro-pericardial membrane, which normally completes the division of the pericardial cavity from the pleural cavity, is carried by the duct of Cuvier, early atrophy of the left vein would result in incomplete development of the left membrane and persistence and enlargement of the left pleuro-pericardial foramen. The fact that all known cases of congenital deficiency of the pericardium occurred on the left side would support this view.

McGarry discusses the embryological significance of the malformation, and expresses the opinion that the occurrence of a patent pericardium is one aspect of a general condition. He explains these cases "by supposing that in the early development of the embryo, some slight injury occurred to the general cœlom, which resulted in a lack of development of the pleuro-pericardial membrane."

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THE RELATION OF THE AMPHIBIAN PARASPHENOIDS.

By Dr H. Leighton Kesteven.

THESIS.

1. The greater part of parasphenoid of the Amphibia is represented in Superamphibia by the paired pterygoids.
2. The amphibian pterygoid appears elsewhere only in some Reptiles, in which it has been named Ectopterygoid.
3. The reptilian parasphenoid represents the anterior portion only of the amphibian parasphenoid.

If it be proven that the amphibian parasphenoid is truly represented by the reptilian pterygoids, then it follows that the reptilian parasphenoid can represent, at most, only part of the amphibian parasphenoid. Our knowledge of cranio-ontogeny is as yet fragmentary, and comparisons have been largely based on considerations of types rather than groups, and this is particularly, and necessarily, so when embryological evidence is adduced, since the material is scanty. Thus as a result of the work of many investigators, more especially of Parker and Gaupp, *Lacerta* has come to be accepted as the type or standard of reptilian cranium. In this the parasphenoid, at one stage of development, presents such marked similarity to the amphibian parasphenoid that one hesitates to suggest that it is incorrectly named. Without challenging the homology of these bones, Broom has advanced convincing reasons for regarding them as homologous with the mammalian vomer. It is significant that, with the exception perhaps of some Cetaceans only, in all the Superamphibia the vomer is limited posteriorly in the neighbourhood of the pituitary body, if indeed it extends so far back. Remembering the important muscular attachments to the amphibian parasphenoid at its hinder end, and that there are none to the vomer (or parasphenoid) of higher forms, one inquires, Whither have these attachments wandered? The answer is, In part to the pterygoid both in the Reptilia and Mammalia.

Do these pterygoids represent the posterior portion of the amphibian parasphenoid?

A priori, a bone so extensively developed as the parasphenoid in the Amphibia, and serving such important functions, should not dwindle almost to disappearing point in the process of evolution. As the matter now

stands, such is tacitly accepted as having taken place, for the reptilian vomer (parasphenoid of authors) with few exceptions is so insignificant a bone that it cannot be demonstrated in the dried skull, and we have learned to believe that this remnant represents the amphibian parasphenoid.

A more acceptable interpretation of the bones on the basis cranii is that offered above, namely, the pterygoids of the Reptilia represent the major portion of the amphibian parasphenoid.

If this be so, then the reptilian pterygoids are primitively median in position and should articulate one with the other along the mid-line. Such a primitive condition is realised in the triassic *Notosaurus*, in Chelonia and Crocodilia. In all these we find the paired pterygoids presenting the following important relationships and characters:—

1. They are membrane bones.
2. Meeting along the mid-line, they are placed immediately beneath the basis cranii extending from the occipital region behind to the olfactory region in front.
3. They underlie, without intervening structures, the basi-sphenoid and rostrum basi-sphenoidei (*i.e.* the erstwhile cartilaginous basis cranii).
4. Posteriorly, by lateral expansions, they are related to the quadrate, and underlie the otic capsules.
5. Anteriorly they articulate with the palatine bones on either side of the mid-line, and are related to the posterior nares.
6. Posteriorly they give attachment to muscles of mastication.

Effecting only such changes as are necessitated by the fact that the amphibian parasphenoid is unpaired, the above six statements constitute also a description of this bone.

In the presence of such complete resemblance one is forced to assume a truly remarkable analogous replacement of amphibian parasphenoid by reptilian pterygoids, or admit that the latter are homologous with the former. That the amphibian parasphenoid should be thus homologous with three bones on the base of the reptilian skull involves only the assumption that in the more highly specialised skull the bone develops from three centres of ossification which fail to fuse.

Comparing the ectopterygoid of the crocodile with the pterygoid of *Rana* it will be found that the following hold true in both cases:—

1. The bones are on the postero-lateral border of the infra-orbital region.
2. They are triradiate.
3. The anterior ramus is related to the maxilla, and to the palatine bone *laterally* with respect to the orbit.
4. The postero-lateral ramus is related to the quadrate or quadrato-jugal (*i.e.* to the maxillary arch posteriorly).

5. The postero-medial ramus is related to the parasphenoid (pterygoid of authors, in the Reptiles).
6. Neither of these ever present the median relation to the palatines and choanæ so constantly seen in the reptilian paired parasphenoids (pterygoids).
7. They form a bony bar over which the muscles of mastication work, and which separates the temporal fossa from the orbit.

Once again, if these bones are not homologous then there has been a truly remarkable analogous replacement.

The reptilian pterygoid, like the amphibian parasphenoid, is a membrane bone applied medially to the base of the skull, whilst the amphibian pterygoid and reptilian ectopterygoid are essentially components of the suspensorium.

If the reptilian pterygoid is the same bone as the amphibian pterygoid, then in assuming its reptilian situation it has as it were melted from before backward on the outer aspect of the orbital region, and then grown forward again along the base of the skull medial to the orbital region. In support of such a migration there is no shred of embryological evidence, and intermediate stages in the palæontological record are hard to find. Among recent forms *Cryptobranchus japonicus* may be cited as one such, but it is a long way from the condition presented by the pterygoids in the *Chelonidæ*, *Crocodilia*, and *Sauropterygia*.

It may be contended that the pterygoid in these three groups of skulls is atypical and therefore misleading. Such an argument, however, fails if it be granted as possible that they are evolved from a median parasphenoid, for then they present the primitive type condition. In the absence of such a postulate the examination of a series of other reptilian skulls reveals the fact that these pterygoids differ from those of other members of the class mostly in their size, and not at all in relation to other bones or skull regions—in short, there can be no doubt that it is the same bone which has been termed "pterygoid" throughout the whole reptilian series.

It has been contended that in coming to occupy the position it does, the pterygoid in *Chelone* has undergone medial extension; there is equal justification for supposing that the more laterally placed pterygoids of, e.g., *Lacertilia* have retreated from the median line.

If the reptilian pterygoid is primitively a paired basi-cranial covering bone (parasphenoid), then the process of its conversion into a cranio-visceral skeletal element related to the pharynx and muscles of mastication, perhaps determined by those relationships, and its separation from the basis cranii, may be recognised in its various stages within the class. *Trionyx* presents the first stage, the pterygoids being separated by the

basi-sphenoid; after viewing *Pelochelys* and *Sphenodon* one is more prepared for the condition in the monitors, blue-tongues, and other lizards. In all these cases the relationships to bones and skull areas, emphasised earlier, are maintained.

Particularly interesting are the constant articulation with the basi-sphenoid, just anterior to the pituitary region (basi-pterygoid process), and the relation to the choanæ and Eustachian apertures, inasmuch as these relationships persist in the Aves and Mammalia.

Gaupp is of the opinion that the reptilian vomer (parasphenoid of authors) is homologously replaced by the paired pterygoids of the Mammalia. One of his objections to recognising as homologous the similarly named bones (pterygoids) in the Reptiles and Mammals is the lateral position of the bones in the Reptiles. In this he is apparently obsessed by the situation of the pterygoids in *Lacertilia*. In the Chelonians, Crocodilians, and Sauropterygians, as has already been emphasised, these bones are situate immediately beneath the neural cranium. He believes that the median extension of the pterygoids in *Chelonia* has been brought about by reduction in the basi-pterygoid process, whereas it has just been shown that it is more probably primitive, and therefore the basi-pterygoid process is a later development.

The condition in the Mammals is, in the view here presented, a perpetuation of the anterior segment of the lacertilian condition, namely, that portion extending from the basi-pterygoid process to the posterior naso-palatine border, and the basi-pterygoid process could have (as has been suggested) expanded into the ala temporalis, but dorsal and posterior to it.

Whilst thus differing from him in this instance, I would, however, quote Gaupp's authority in support of my contention that a median basi-cranial bone in one phylum may in another be homologously replaced by paired bones.

It may be well at this stage to emphasise the fact that the original application of the name "pterygoid" to the bones so named in the Amphibia and Reptilia did not result from embryological study, nor has the homology involved ever been confirmed by embryological evidence; in no case does the reptilian pterygoid ever first appear postero-lateral to the infra-orbital region; in all cases hitherto investigated it first appears on either side of the basis cranii, medial to that region.

The reptilian ~~o~~cto-pterygoid, chosen above for comparison with the amphibian pterygoid, is admittedly better developed than is usual in most reptiles; on the other hand, the amphibian type chosen is the best developed in that class. Though this bone presents a fairly wide range of variation

in both classes, there can be no doubt that it is always the same bone that is termed ecto-pterygoid in the Reptilia, and in the Amphibia, pterygoid. That the variations do not affect the arguments set forth above, is shown in the following table:—

Ecto-pterygoid and Pterygoid (Amphibian).	Pterygoid (Reptilian).
Always lateral or postero-lateral to the orbit.	Never lateral to the orbit.
Never medial to the orbit.	Always medial to the orbit.
Articulation with the lateral portion of the posterior margin of the palatine bone.	Articulation with the medial portion of posterior margin of the palatine bone.
Anteriorly separated from its fellow of the opposite side by the whole width of the postnarial region.	Never so separated.
The two bones are never in juxtaposition medially in front.	The two bones are always in juxtaposition medially in front.
In no case do these bones articulate with the basi-sphenoid.	These bones always articulate with the basi-sphenoid.
Postero-medially they are always in juxtaposition to the membrane bone covering the base of the skull.	Postero-medially these bones *constitute* the membrane bone covering the base of the skull, or else there is no such bone developed.

This table is largely a repetition of previous discussions, but placing in contrast the relationships of reptilian and amphibian pterygoids, it emphasises the difficulties in the way of the homology involved in the old nomenclature. It is hardly believable that these bones, whose most important relations to other bones and regions of the skull are capable of correct description, thus, in alternate negative and affirmative, are really homologous. On the other hand, it is equally difficult to believe that the two bones described together in the left-hand column are not homologous.

It is therefore to be concluded that:

1. The reptilian pterygoids are wrongly named, they should be termed paired parasphenoids, and they represent the major portion of the amphibian parasphenoid, with which they are completely homologous.
2. The reptilian ecto-pterygoids should be termed pterygoids, and they are completely homologous with the amphibian pterygoids.

THREE CASES OF REAPPEARANCE OF OVARIAN PERITONEAL SACCULATION IN THE HUMAN FEMALE. By EDWARD REYNOLDS, M.D.

SINCE we have come to realise that the embryological record furnishes merely a sketch of the main lines of descent, and that the developmental peculiarities observed in individuals not only have the same significance of reversion to ancestral traits, but are for that reason capable of filling in the details of descent, the submission to record of every such observation has become of greater importance.

The relation of the ovary to its endometrium is not only extremely variable throughout the Vertebrates, but is interesting in the fact that the occurrence of sacculation is irregular in its distribution, frequently appearing in individual species among genera which are otherwise free from it. I have, however, been able to find no previous record of the occurrence of this relation among individuals in a species which is normally free from it. The human female is normally peculiar among the Vertebrates in possessing an almost, if not quite, complete absence of any trace of peritoneal sacculation of the ovary, hence the study of three individuals in which this anomaly appeared seems worthy of record.

The anatomical relations of the ovary to the adjacent peritoneum vary widely as between different species of the same family in almost all genera throughout the mammalian kingdom. The ovary is always attached by one border only to the inner or medial surface of the mesometrium or broad ligament. In the simplest form of its peritoneal relations it hangs dependent from this attachment with its outer surface in simple contact with the inner surface of the mesometrium, more commonly the surface of the broad ligament which is in contact with the ovary is recessed into a shallow depression against which the ovary lies. From this simplest form of the relations all gradations are met with up to those in which this depression has been not only deepened into a pouch, but its orifice contracted until the ovary and the fimbriated extremity of the Fallopian tube lie in an accessory cavity of the peritoneum which is entirely closed from the general cavity. These modifications of the relations of the ovary to the body cavity are, moreover, foreshadowed by similar arrangements which exist even among the Invertebrates. The literature on the subject is scanty. Reference to it, however, occurs with considerable frequency in

Owen's *Anatomy of Vertebrates*, in which, moreover, there is frequently reference to monographs describing individual species. The only detailed article upon the subject which I have been able to find, after somewhat extensive search, is one by Professor Arthur Robinson.[1] This article gives excellent figures of several typical modifications, and since excellent examples of most of them occur in the common domestic animals, personal verification of these figures is comparatively easy.

I have not been able to find any reference to a species in which there is no depression of that portion of the broad ligament which is in contact with the ovary, although it is stated that this form is known. The human female, however, offers an excellent example of almost this condition, the accepted description being that the ovary lies in contact with a shallow depression in the surface of the broad ligament, while my own observations have made me somewhat doubtful as to whether this depression is habitually perceptible; but this question will be referred to later. An excellent example of an early stage of the formation of the pouch is to be found in the common cat; an intermediate stage of development of the ovarian sac exists in the porcupine; and the most complete form known in the common mouse, in which the peritoneal covering of the edges of the orifice have become fused with the peritoneal covering of the Fallopian tube, so that the ovary and fimbriated extremity are entirely shut off from the general cavity.

The distribution of the ovarian sacculus through the mammalian kingdom is roughly as follows. Each of the different families shows for the most part a general tendency either to more or less complete sacculation of the ovary or to its absence, but the amount of sacculation varies very greatly among the different species within the genus.

In the Monotremata and Marsupials the ovary lies in contact with a shallow peritoneal groove. In the Insectivora there is as a rule a nearly complete sacculus. Among the majority of the higher genera any approach to complete sacculation is exceptional, but it is prevalent in several widely separated families.

In the Perissodactyla the anatomy varies between deep but widely open saccules and the condition found in the mare, in which the ovary lies enclosed and concealed in its special peritoneal cavity.

Among the horned Ruminants the existence of a sac is the rule, but the degree of enclosure varies within wide limits.

The ovaries of the Carnivora are mostly contained within saccules, that of the white bear being so nearly complete that only a minute communication with the general cavity is left.

[1] *Journ. Anat. and Physiol.*, London, 1886–7, vol. xxi. p. 169.

The Rodentia are peculiar in that they exhibit every variety between a mere shallow depression in the peritoneum of the broad ligament and the condition found in the rat and mouse, in which the ovarian sac is absolutely shut up in the broad ligament and its one opening is its communication with the cavity of the uterus through the Fallopian tube.

Among the Primates a rudiment of the sacculus is found in *Perodicticus*, *Lichanotis*, *Otolicnus*, *Tarsius*, and *Stenops*.

I have been unable to find any reference to individual variation in the amount of sacculation within the limits of any species, though such may very probably exist.

When an ovarian sacculus exists it always lies within the cavity of the mesometrium.

In the Monotremes and Marsupials the uterus is double, and in one of my human cases the anomaly of double uterus was present. In the majority of the Mammals it is bicornuate, consisting of a body and two diverging cornua. In the Primates it is single throughout, the Fallopian tubes originating from the angles of the single body.

In the human female the mesometrium or broad ligament has been developed under the requirements of the erect posture into a highly specialised supporting structure containing well-developed so-called ligaments (most of which are non-existent in the quadrupeds), by which process it is altered from the very simple and almost linear form which it possesses in most Mammalia to an irregular, quadrilateral, and very complicated shape. These great changes make a comparison of the human broad ligament with that of the quadrupeds difficult and at times misleading. In the human female the large and long Fallopian tube is usually described as lying in the free edge of the broad ligament. It may more properly be said that, owing to the development of the round ligament, the broad ligament possesses no true edge, but that the Fallopian tube has developed its own proper mesosalpinx of considerable length springing from that surface of the broad ligament which would be described as the internal surface in quadrupeds. If the mesosalpinx be regarded as a separate structure, and for the moment neglected, this internal surface of the broad ligament may be described as running inwards and backwards, *i.e.* towards the vertebral column, with its surface diversified only by a ridge or fold which encloses the utero-sacral ligament. This so-called ligament is composed in the main of unstriped muscular fibre, and the angle formed by its elevation from the smooth surface of the broad ligament in general is what has been described as a depression in which the ovary lies; in point of fact, the ovary in health and in the living subject is maintained in a position considerably anterior to this depression by the

contractility of its own intrinsic supports, and after study of these relations in a now considerable number of cases on the living woman I feel confident that this so-called depression bears no more than an accidental relation to the ovary, which is, in fact, in the normal human female in contact with a broad ligament which shows no trace of an ovarian depression.

This view is supported by a fact of great significance. The ovary in all Mammalia is, as has been said, attached to the broad ligament only by its hilum and hangs dependent therefrom. In the position commonly occupied by the human female the ovary drops towards the vertebral column and therefore towards the utero-sacral ligaments, but if the woman be placed in the position of the quadrupeds the ovary would necessarily hang away from the utero-sacral ligament and towards the situation of the

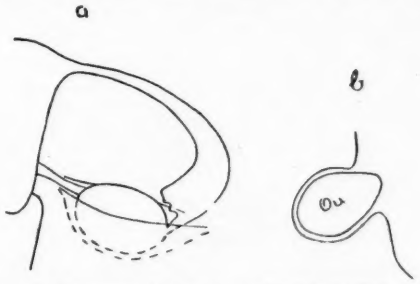

FIG. 1.—*a*, diagrammatic sketch of peritoneal relations of ovary in Case 2; *b*, diagram of probable cross section.

Fallopian tube, that side of the ovary which in the ordinary position is in contact with the peritoneum of the broad ligament being now away from it, and the groove formed by the elevation of the utero-sacral ligament being therefore at a distance from the ovary, and from the site of its relation to the peritoneum of the broad ligament. It is difficult to believe that an elevation in the broad ligament (that due to the utero-sacral), situated on the other side of the broad ligament from the position of the tube, can be in any way homologous to the depression near the orifice of the Fallopian tube which is believed to represent the first stages of the formation of the ovarian sacculus in the quadrupeds.

It seems, then, that the human female may be described as an animal in whom the ovary normally possesses the simplest of all peritoneal relations, that of an ovary hanging in contact with a broad ligament in which no depression is visible.

I have found no reference to a variation from this normal absence of

sacculation in the human female, but I wish to place on record three cases, all observed on the living subject, in each of which the right ovary was nearly completely sacculated.[1] In the instance first observed the significance of the condition was not understood and only a verbal description was recorded. In the other two cases the exigencies of the operation prevented the making of a sketch during the actual exposure of the organs, but in each case an effort was made to fix upon the mind the exact visual image, and a sketch of the conditions found was made immediately after the completion of the operation (figs. 1 and 2). These sketches are necessarily somewhat incomplete as to details, but I feel confident that those details which were inserted are correct.

In all three cases the operation was undertaken for the relief of pain caused by pathological enlargement of the ovary and the tension con-

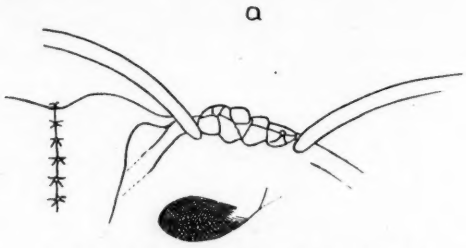

FIG. 2.—Sketch of Case 3, with resected ovary elevated by forceps and mouth of sacculus consequently stretched open.

sequent upon the development of this condition within the comparatively rigid confines of the sac.

In the second case operated upon, the accessory peritoneal cavity consisted of a deep groove between two folds of the broad ligament, *i.e.* of a cavity the opening of which extended its entire length and was considerably longer than the longest diameter of the enlarged ovary. The extremely diagrammatic sketch appended gives some idea of the anatomy. Greater detail was not possible, as the conditions of the operation made visual inspection of the anomaly difficult and intermittent, and the sketch is compiled partly from visual inspection and partly from what was obtained by digital touch. The latter process is, however, to the skilled touch in some respects more illuminating than ocular inspection, more especially in regard to the shape of the cavity and the construction of its walls.

In the third case, illustrated by a less diagrammatic sketch (fig. 3), continuous and clear inspection was obtained and supplemented by the

[1] Note that in many Vertebrates the right ovary is normally undeveloped.

touch. In this case the orifice of the sacculus was considerably shorter than its cavity. The entire ovary and the fimbriated extremity of the Fallopian tube were hidden within the cavity, and the ovary in its enlarged state was so much larger than the orifice that it was possible to withdraw it only by working it around within the capsule until it presented by one pole, when it was withdrawn by traction on the utero-ovarian ligament.

In the first case operated upon, my recollection of the appearances and conditions, which seems to me very vivid, were that they were closely similar to those of the case last described, which impression is confirmed by the verbal description recorded at the time.

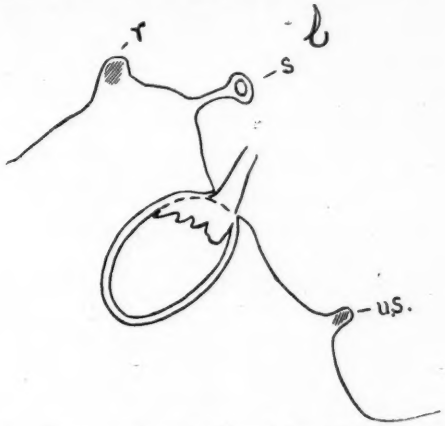

FIG. 3.—Diagrammatic section through broad ligament of Case 3, parallel to mesial section and cutting sacculus.
r, round ligament; *s*, salpinx; *u.s.*, utero-sacral.

The relations between the situation and anatomical construction of the pouches in these three cases, and the situation and anatomy described by Robinson for the Vertebrates, in which these sacculæ are normal, is of interest.

According to Robinson, the mesial layer of the broad ligament in the quadrupeds always contains two strands of fibrous tissue, which were perhaps better described by Owen as the anterior and posterior portions of the same (ovarian) ligament. They should properly be considered as one ligament, since their extremities evidently coalesce in the hilum of the ovary, and their function is the support of this organ. The outer portion extends in the quadrupeds from the posterior extremity of the ovary to the tip of the cornu uteri. The anterior portion extends forward from the anterior

extremity of the ovary, and is either lost in the broad ligament on the outer side of the kidney or passes forward to the diaphragm.

In the human subject the uterine extremity of this ovarian ligament does not arise from the cornu of the uterus, but from the lateral edge of the organ at a somewhat variable position, usually near the lower part of the corpus, occasionally as high as perhaps a half-way position between the cornu and the situation of the internal os, the lowest portion of the corpus. (It must here be remembered that in the human subject a considerable portion of the volume of the uterus is made up of a differentiated cervix, which is either of little size or almost undifferentiated in the other mammals.) The anterior extremity of the ligament is lost in the subperitoneal tissues at about the brim of the pelvis and a little to the outer side of the ureter. In the human female this so-called ligament has been shown of recent years to be largely composed of unstriped muscular tissue.

In the quadrupeds, or at least in those few species which I have been able personally to inspect, these two ligaments or portions of a ligament lie at a considerable angle to each other with the ovary at the apex of the angle, and the third or anterior edge of the triangle is formed by the Fallopian tube. This arrangement is shown in each of Robinson's figures. Robinson states that the ovarian pouch or sac is formed in this triangle, its walls consisting of reduplications of peritoneum about the two portions of the ligaments and the base of the Fallopian tube. The ovarian ligament is thus always in the vertebral or dorsal (medial) wall of the pouch, and it must be noted here that in the ordinary position of the quadruped the ovary is ventrally dependent from this ligament, thus falling into the pouch so formed.

In the human female, on the other hand, the two portions of the ovarian ligament are in the same line, *i.e.* the ligament as a whole is straight, and in the ordinary position of the woman the ovary is dorsally dependent, *i.e.* falling away from the Fallopian tube, instead of towards it as in the quadruped.

In all three of my cases the Fallopian tube entered the slit at its outer (in quadrupeds anterior) end, and both portions of the ovarian ligament could be seen to enter the inner and outer ends of the slit. In the first two cases it did not occur to me to ascertain whether the ovarian ligament, *i.e.* that portion of the ovarian ligament which is contained in the hilum of the ovary, lay in the outer or inner wall of the pouch, but since the relation of the ovary to the tube and broad ligament in general after its extraction from the pouch was precisely similar in all three cases, it is probable that the relation of the ovarian ligament to the pouch was in all the cases that which is shown in the sketch of the third case. In this sketch it is readily seen that the uterine ligament as a whole is ventral to the opening of the

slit, *i.e.* that the hilum and the ovarian ligament lie in what would be described in animals as the outer wall of the pouch,—a situation in which the ovary would fall into the pouch by gravity in the ordinary position of the woman,—while both my own observations and Robinson's figures show that in the quadrupeds the hilum and the ovarian ligament are on the dorsal edge of the pouch, *i.e.* contained in its inner wall. In the ordinary position of the quadruped this arrangement would again ensure the ovary's dependence into the pouch under the influence of gravity.

This alteration of the relation of the sac to the ovarian ligament suggests a correlation with the altered habitual attitude of the species, in all other respects the ovarian sacs observed in these three women appear to be homologous with the sacs which are normal in so many of the quadrupeds.

OMPHALOPAGOUS TWINS IN THE HUMAN SUBJECT.

By Dr James F. Gemmill and Mr James Stewart.

Conclusion.—Ventral union, limited (as far as the parietes are concerned) to the umbilical region, can occur in human twins, and accordingly the type *Omphalopagus* should receive a place in the classification of Mammalian Double Monstrosities, its position being intermediate between *Xiphopagus* and *Lecanopagus* or *Ischiopagus*.

Description of Specimen.

The specimen consists of full-time female twins united face to face in the umbilical region by an isthmus which expands mesially to form a sac of considerable size. In each twin the epidermis of the body wall extends over the neck of the isthmus and over a small portion of the sac, but not more than a quarter of the total surface of the sac has natural skin over it, the remainder being covered by a thin, pinkish, semi-transparent membrane. Both subjects are in rather an emaciated condition and one of them has well-marked talipes varus on the left side. There is no anal aperture in either case, but the twin with the club-foot shows an anal depression. The labia are well developed, and on separating them a distinct opening is seen in each case. This has proved to be the external opening of the urogenital canal.

Measurements.—Length from top of head to coccyx, 28 to 30 cm. Full length when stretched out, 62 to 63 cm. Circumference of common sac, 27·5 cm. Circumference of neck of isthmus in club-foot twin, 18 cm.; in other twin, 8 cm.

Only one umbilical cord is present, its place of origin being the middle of the common sac, on the side away from the club-foot. A cut edge of membranous tissue running transversely round the sac is probably a remnant of the fused amnia.

The twins had a common placenta and a short common umbilical cord. They survived for several days. A third child, born shortly after them, had separate membranes and placenta, was healthy and well developed, and is still alive.

The clinical aspect of the case has been described elsewhere (*Lancet*, London, April 1, 1916) by Dr Robert Jardine, in whose wards at the Glasgow Maternity Hospital the birth occurred, and through whose

courtesy and that of Professor T. H. Bryce the specimen was handed to us for examination.

Peritoneal Cavities and Mesenteries.—The peritoneal cavities of the twins communicate freely in the central mass, which consists chiefly of coils of intestine. The dorsal mesentery is retained throughout, except that the commencement of the duodenum is bound down to the posterior abdominal wall near the middle line. The great omentum is absent, but in both twins there is a wide epiploic foramen leading into a peritoneal recess lying behind the stomach and clothing about half of its posterior aspect.

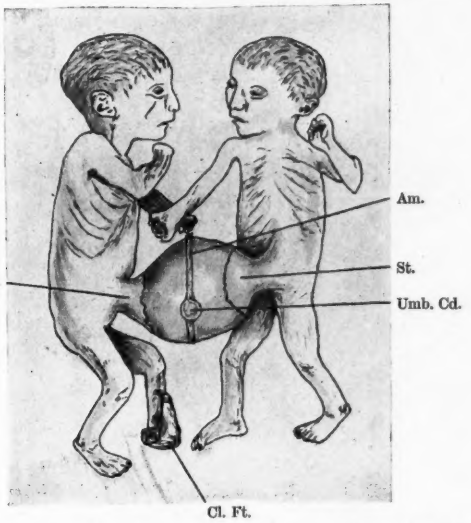

FIG. 1.—Outline drawing of specimen, showing the general character of the union.

Alimentary Canal.—In both twins the small intestines proceed in coils through the stalk into the central mass, where they unite 2·5 cm. from the ileo-cæcal junction. The common canal opens into a large cæcum which shows two vermiform appendices, each appendix being placed slightly to the left of the mesentery coming from the twin to which it belongs. The cæcum and colon are very greatly distended with fæcal material. The large intestine is 23 cm. long, its lumen admitting the passage of two fingers. It is contained within the central mass, but towards its termination it sends a short horn into the pelvis of the twin without the club-foot, the horn being continued as a solid fibrous band in the direction of the anal depression previously noted as being present in this twin.

Vascular System.—No branches of the superior mesenteric arteries proceed to the cæcum or the colon, which are entirely supplied by the inferior mesenteric arteries. These vessels pass through the connecting stalk into the central mass, where, after branching repeatedly, they are distributed each to its own side of the intestine. A superior hæmorrhoidal branch is absent. Three of the hypogastric or allantoic arteries are of large size and enter the umbilical cord, while the remaining one, namely,

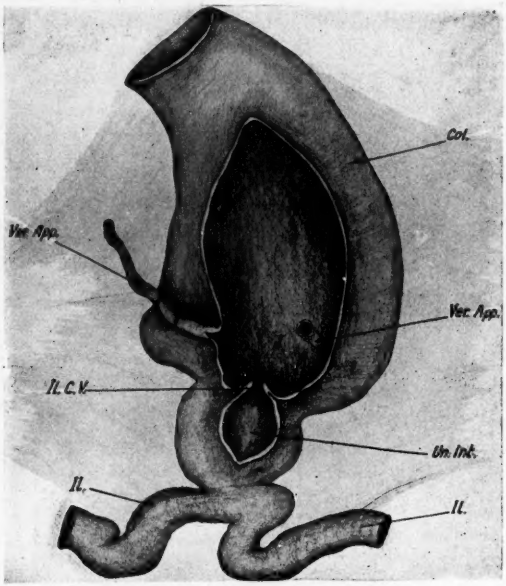

FIG. 2.—Common cæcum and fused portion of intestine opened up. The appendix of the twin without the club-foot is on the left of the figure, while the opening into the appendix of the club-foot twin is shown in the floor of the cavity.

the right hypogastric artery of the twin without the club-foot, is a small vessel which becomes lost on the abdominal wall of this twin in the region of the isthmus neck. Two umbilical veins are found in the root of the cord, one coming from each twin.

Urogenital System.—In both twins all the Müllerian duct derivatives are doubled, the Fallopian and uterine tubes in each being widely separated from one another, the latter opening into vaginæ dilated with fluid. The vaginæ open in turn into the urogenital canal, and the contained fluid was found to have plentiful urinary salts in solution.

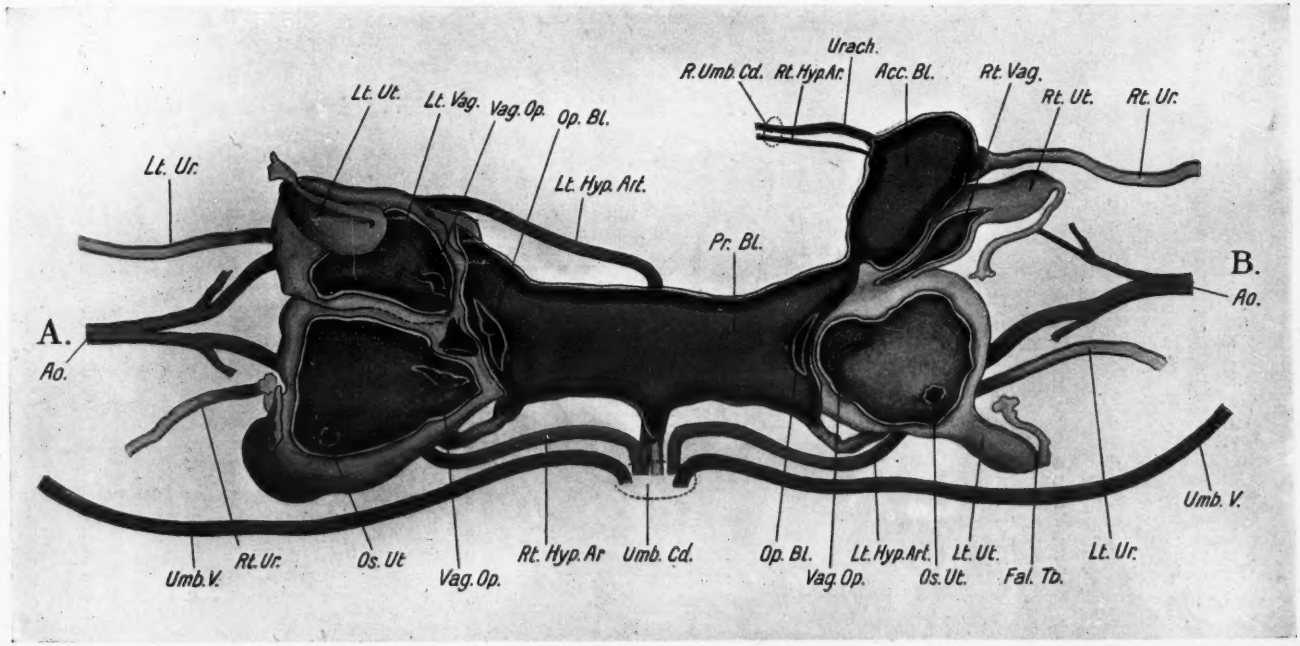

FIG. 3.—Diagrammatic representation of a dissection of the urogenital system of the twins, looked at from above. The cavities of the vaginæ and bladders have been opened up so as to exhibit the floor of each with the various openings leading therefrom.

A, on side of twin with club-foot.

B, on side of twin without club-foot.

In the central mass, below the insertion of the umbilical cord, is a large principal bladder with two necks, one passing downwards into the pelvis of each twin and continued into a corresponding urogenital canal. This bladder receives the two ureters of the club-foot twin, but only the left ureter of the second twin. The last-named twin has its right ureter opening into a small accessory bladder in the right hypogastric region. This bladder is surmounted by a small urachus, and opens through a short narrow passage into the body of the principal bladder. It will be remembered that the right hypogastric artery of the same twin was small

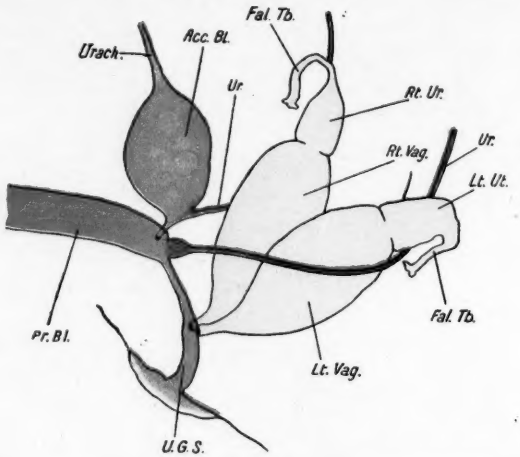

FIG. 4.—Diagram of urogenital system of twin without the club-foot, showing the various openings into the bladders and urogenital sinus. In the case of the club-foot twin the arrangement is similar, except that no accessory bladder is present, both ureters opening into the principal bladder.

and did not pass into the neck of the isthmus. The urachus and small hypogastric artery, just referred to, hint at a second but altogether rudimentary umbilical complex on the side of the isthmus opposite to that on which the functional umbilical cord is placed. The two necks of the principal bladder lead each into a urogenital passage which, after receiving the openings of a pair of vaginæ, comes to the surface between the labia majora.

DISCUSSION.

The specimen belongs to the "Siamese Twin" group of monsters, in which there is anterior and posterior doubling (*Anakatadidymus*, Förster (5)),

the union being on the whole a face-to-face or ventral one. In this case the union is exactly face to face, except for the fact that the umbilical cord is single and comes off from one side of the central mass.

With the doubtful exception referred to below, our specimen appears to be unique among mammalian monstrosities, since no example of "Siamese Twins" has so far been described in which the union is confined to the umbilical region, leaving the skeletal structures of both sternum and pelvis entirely unconnected with one another. Thus in Saint-Hilaire's classification (7, pt. iii. p. 67) the group of monsters which might be expected to include the specimen described in this paper, contains the following types: *Ischiopagi, Xiphopagi, Sternopagi, Ectopagi* (*i.e.* with lateral union along whole of thorax), *Hemipagi* (*i.e.* with lateral union along whole of thorax and neck). Similarly in Schwalbe's (8, p. 113) classification, the group into which our specimen should fall is subdivided as follows: *Prosopothoracopagus, Thoracopagus, Sternopagus, Xiphopagus, Ileoxiphopagus, Ileothoracopagus, Cephalo-ileo-thoracopagus.* There is a similar blank in the classificatory systems of other authors, *e.g.* Förster (5), Ahlfeld (1), Stewart (9), Taruffi (10), and Ballantyne (3). Cleland's sub-type, *Union confined to the neighbourhood of a common umbilicus*, contains but is wider than *Omphalopagus*, since it includes also the xiphopagous Siamese Twins (4, p. 134).

The term *Omphalopagus* was introduced by Geoffroy Saint-Hilaire (7, pt. iii. p. 107) to describe a double monster chick in which there was superficial union in the umbilical region by the anterior portion of the vitellus. He adds that a double human fœtus figured by Aldrovandi (2) is the only other example of this kind of monstrosity he could find described. Aldrovandi's figure shows twins united by a narrow isthmus at the umbilicus; one of them having only a single hind-limb, a right limb to judge by the figure. The description (2, p. 634) is as follows: "Pariter in Pago Vallis superioris Arni Tertanio nuncupato, anno salutis humanæ post millesimum, et trecentesimum decimo sexto monstrum natum est referens duos Gemellos umbilico copulatos, quorum alter duo crura, alter vero unum tantummodo habebat ut in Icone I ostenditur." Doubt has been thrown by Taruffi on the correctness of Aldrovandi's figure, on the ground that the monstrosity had been previously figured by Licosthenes not *ad naturam* but from a somewhat more detailed description than that given by Aldrovandi. Taruffi believes the specimen was really an example of *Dicephalus tripus tetrabrachius* (10, pt. ii. p. 574).

The omphalopagous type of monstrosity finds its best illustration among the osseous fishes. In the trout and salmon, for instance, union of symmetrical twins by the yolk-sac only is by no means uncommon (Gemmill, 6),

and in rare cases survival for a time may occur. As Geoffroy Saint-Hilaire (7, pt. iii. p. 107) pointed out, omphalopagous union can readily occur wherever the egg is large and the yolk-sac is not cast off but taken into the body.

It need hardly be said that the twins are unioval in origin. Probably the germinal areas from which they developed were situated opposite to one another on the wall of the blastocyst. There may have been only one entodermic sac, but more probably there were two such sacs which became confluent posteriorly on their ventral aspects. The fused portion of intestine in our specimen corresponds with the tract normally developed behind the origin of the omphalo-mesenteric duct from the apex of the primitive umbilical loop of intestine. The great hernia into the central sac recalls in exaggerated form the exomphalic condition of portions of the alimentary canal, which is characteristic of the earlier stages of human development.

We may note that instances of simple bifurcation of the umbilical cord (*i.e.* funicular union) may occur in the case of homologous twins (Ahlfeld, 1, p. 17). In our specimen the cord and placenta were unfortunately not available for microscopical examination, so that we cannot say whether a yolk-sac and vitelline duct were present. It would appear, however (Ahlfeld, 1, p. 17), that homologous twins sometimes possess completely separate yolk-sacs.

ABBREVIATIONS.

Acc. Bl. . . Accessory bladder.
Acc. Umb. Cd. Accessory umbilical cord.
Am. . . . . Amnion.
Ao. . . . . Dorsal aorta.
Cl. Ft. . . . Club-foot.
Col. . . . . Fused colon.
Fal. Tb. . . Fallopian tube.
Il. . . . . Ileum.
Il. C. V. . . Ileo-colic valve.
Lt. Hyp. Art. . Left hypogastric artery.
Lt. Ur. . . . Left ureter.
Lt. Ut. . . . Left uterus.
Lt. Vag. . . Left vagina.
Op. Bl. . . . Opening of bladder into urogenital sinus.
Os Ut. . . . Os uteri.
Pr. Bl. . . . Principal bladder.
R. Umb. Cd. . Rudimentary umbilical cord.
Rt. Hyp. Ar. . Right hypogastric artery.
Rt. Ur. . . . Right ureter.
Rt. Ut. . . . Right uterus.
Rt. Vag. . . Right vagina.
St. . . . . Connecting stalk.
U. G. S. . . Urogenital sinus.
Umb. Cd. . . Umbilical cord.
Umb. V. . . Umbilical vein.
Un. Int. . . Fused part of intestine.
Ur. . . . . Ureter.
Urach. . . . Urachus.
Vag. Op. . . Opening from uterus into vagina.
Ver. App. . . Vermiform appendix.

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A PALMARIS LONGUS MUSCLE WITH A REVERSED BELLY, FORMING AN ACCESSORY FLEXOR MUSCLE OF THE LITTLE FINGER.

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DURING the dissection of an arm, amputated for a severe compound fracture of the humerus, a curious muscle was found lying in front of the left wrist.

Description.—Taking origin from the tendon of the palmaris longus about 2 inches above the wrist, it passed as a small somewhat flattened muscle belly, distally and medially, into the palm of the hand. It lay first upon the tendons of the flexor sublimis digitorum, and then crossed the anterior carpal ligament, keeping close to the os pisiforme. When the muscle had been hardened *in situ* this bone was found to have left a distinct indentation upon its medial border.

About one-quarter of the distance from the pisiform to the base of the 5th metacarpal, the muscle belly tapered off into a delicate tendon which ran on between the abductor minimi digiti and the opponens. With both muscles it finally blended, receiving a common insertion into the base of the proximal phalanx of the little finger on its medial side. A fascial expansion passed to the common extensor tendon on the dorsal aspect of the joint.

In the photograph a rod is seen passed under the tendon of the palmaris longus. The palmaris brevis has been reflected and the mesial portion of the palmar fascia dissected away to show the entire length of the muscle.

Nerve Supply.—The nerve supply was double. Two minute twigs, both from the ulnar nerve, entered its substance. One of these was given off above the level of the wrist joint and entered its deep surface; the other, an offshoot from the branch of the ulnar to the medial border of the little finger, entered the muscle just below the pisiform on its medial border. The trunk of the median nerve lay in direct contact with the deep surface of the muscle as it crossed the anterior carpal ligament.

Blood Supply.—The arterial supply came from the ulnar artery and accompanied the nerves.

Action.—When this muscle contracted it must have resulted in strong flexion of the small finger with a distinct tendency towards opposition. It can only have exerted its maximum power, of course, when the palmaris longus was also in contraction.

Remarks.—The patient, a soldier, had been in civil life a labourer. He told me afterwards that he had never noticed anything unusual about his left hand or its little finger. It had not been stronger or more useful than the right. His other hand was carefully examined, but no trace of a

similar muscle could be seen, although his palmaris longus was strongly developed. There did not seem to be anything unusual in the range, power, or delicacy of movement in the little finger of the right hand, nor were any other bodily peculiarities discoverable.

The muscle described above is doubtless an additional belly of the palmaris longus. This extremely variable muscle is said to be occasionally digastric, and to have insertions into the muscles of the thumb or little finger.

NOTE.—The digastric condition of palmaris is very rare. The condition of a palmaris with a long tendon of origin and a reversed belly just above the wrist is not very uncommon, and this seems to be the condition existing in this specimen. In a number of the examples of this reversed palmaris it coexists with a normal palmaris, from which it differs in having an ulnar nerve-supply. J. T. M.

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